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The Foothills Mount Ainslie - Stage 1
Doma Group
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Development Application Acoustic Assessment

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by Doma Group to prepare an Environmental Noise Emission Assessment for The Foothills Mount Ainslie.

The Foothills Mount Ainslie is a proposed residential development at Blocks 4 and 5, Section 38 Campbell, ACT.

This report relates to Stage 1 of the proposed residential development only, comprising Precincts 1, 2, 3, 4 and 6. Precinct 5 does not comprise part of Stage 1 and is not covered by this report.

The information set out in this report is for information in order to facilitate a compliant and functional building and does not reflect the final design for the constructed building. Further development of calculations and treatment strategies will be determined in the detailed design phase of this project.

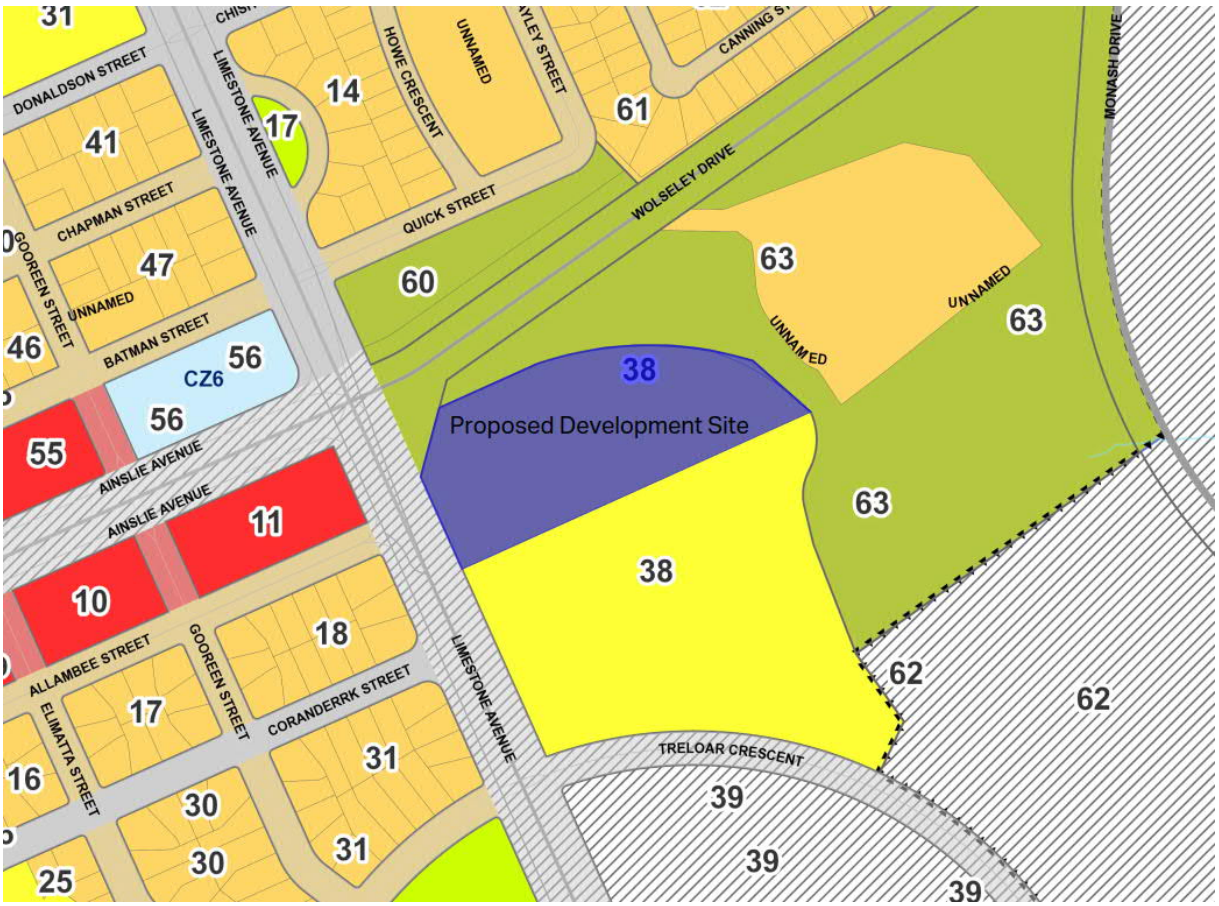
Appropriate operational environmental noise emission criteria for the development have been established in this report and are based upon Schedule 2 of the Environment Protection Regulation 2005 (EPR 2005).

The acoustic terminology used in this report is explained in Appendix A.

1.1 Development Description

The proposed development site is located at 30 Limestone Avenue on Blocks 4 and 5, Section 38, Campbell.

Figure 1 Site location



The proposed development comprises:

Precinct	Number of Buildings	Type of Dwellings	Number of Units	Total Units	Carparking			
					Residential	Visitors	Provisional	Total
1	2	Apartments	114	**209**	161	-	-	**445**
2	7	Townhouses	43		90	44	25	
3	7	Townhouses	38		76			
4	1	Townhouses	14		49			
5	Future works – not part of this report							
6	Infrastructure							

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2.0 Assessment Criteria

2.1 Environmental noise emission criteria

Schedule 2 of the Environment Protection Regulation 2005 document (EPR 2005) specifies information regarding noise zones, noise standards and conditions. Noise zones are applied to ACT land and have associated noise standards (measured in L_{10} dB(A)). Part 3 (Noise) of the EPR 2005 references Schedule 2 and provides definitions and information into the noise regulations for the ACT.

The zoning of ACT land is described within Schedule 2, Part 2.1 of the EPR 2005 and is replicated in Table 1.

Schedule 2, Part 2.2 of the EPR 2005, states the allowable L_{10} noise levels for each zone as presented in Table 2.

Table 1 Table 2.1 Environment Protection Regulation 2005

Column 1 item	Column 2 noise zone	Column 3 ACT land	Column 4 NSW land
1	zone A	land in an industrial zone	land in the Queanbeyan city industrial zone
2	zone B1	land in the city centre or a town centre	
3	zone B2	land in the Central National Area (City Hill Precinct)	land in the Queanbeyan city business zone
4	Zone C1	land in a group centre	
5	zone C	land in a corridor site or an office site	
		land in the Central National Area (Parliamentary Zone and Other Areas)	
6	zone D	land (other than land in the city centre, town centres, and group centres) in a commercial CZ4 zone	
7	zone E	land (other than land in the city centre, town centres and group centres) in— • a restricted access recreation zone • a broadacre zone	
8	zone F	land (other than land in the city centre, town centres and group centres) in— • a commercial CZ5 zone • a TSZ2 services zone • a community facility zone • a leisure and accommodation zone	land in the Queanbeyan city special uses zone
9	zone G	all other land, other than land in the Central National Area (Fairbairn)	all other NSW land

Table 2 Noise zones other than zones B1 and C1 - Table 2.2 from the Environment Protection Regulations 2005

Column 1 item	Column 2 noise zone	Column 3 noise standard (dB(A)) Monday-Saturday 7am-10pm Sunday and public holiday 8am-10pm	Column 4 noise standard (dB(A)) Monday-Saturday 10pm-7am Sunday and public holiday 10pm-8am
1	zone A	65	55
2	zone B2	60	50
3	zone C2	55	45
4	zone D	50	35
5	zone E	50	40
6	zone F	same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period	
7	zone G	45	35

2.1.1 Site Specific Criteria

The development site, Blocks 4 and 5, Section 38, Campbell, are classified as CF: Community Facilities.

The adjacent noise sensitive receivers and their noise standards are presented in Table 3 below.

Table 3 Noise sensitive receivers and applicable noise standards

		Land Use Zone	Noise Zone	Noise standard L_{A10}, dB(A)	
				Day	Night
North	Block 4 Section 63 Campbell	NUZ3: Hills, Ridges and Buffer Areas	Zone G	45	35
	Block 2 Section 60 Ainslie	NUZ3: Hills, Ridges and Buffer Areas	Zone G	45	35
South	Block 2 Section 38 Campbell	CF: Community Facilities	Zone F[1]	45	35
East	Block 4 Section 63 Campbell	NUZ3: Hills, Ridges and Buffer Areas	Zone G	45	35
	Block 1 Section 63 Campbell	RZ1: Suburban	Zone G	45	35
West	Block 5 Section 56 Braddon	CZ6: Leisure and Accommodation	Zone F	45	35
	Block 1 Section 11 Reid	RZ4: Medium Density Residential	Zone G	45	35
	Section 18 Reid	RZ1: Suburban	Zone G	45	35

Notes:

1. Takes on noise standard for the adjoining noise Zone G.

2.1.2 Modifying Factors

Where noise sources contain certain characteristics, such as tonality, modifying factors corrections are applied to account for the greater annoyance that the sources may cause.

The ACT Noise Measurement Manual provides the corrections to be applied. These are presented in Table 4.

Table 4 Modifying factor corrections

Factor	Assessment/Measurement	When to Apply	Correction
Tonality	One third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz • 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive • 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB
Low-frequency noise	Measurement of C-weighted and A-weighted level	Measure to assess C- and A-weighted levels over the same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB
Impulsive noise	A-weighted fast response and impulse response	If a difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction up to a maximum of 5 dB
Intermittent noise	Subjectively assessed	Level varies by more than 5 dB	5 dB
Duration	Single-event noise duration may range from 1.5 min to 2.5 hr	One event in any 24 hour period	0 to -20 dB

2.1.3 Standards for units

In addition to the environmental noise emission criteria established above, the Environment Protection Authority's Noise Environment Protection Policy (January 2010) provides additional requirements for environmental noise emission from other units within the same units plan as follows:

> *Noise generated by an activity in another unit must not exceed 5 dB(A) below the noise standard in their unit (Section 24(2)(a) of the regulation). This lower limit provides equity with people living in free-standing house who can take certain actions to reduce noise from neighbours.*

2.2 Traffic noise intrusion criteria

The Roads ACT Noise Management Guidelines (June 2018) provides acoustic criteria for proposed noise sensitive developments located close to arterial or major collector roads. The Guideline definition of a noise sensitive development including apartments, attached houses and detached houses. Limestone Avenue, adjacent to the development site, is considered an arterial road.

The target maximum external traffic noise levels for residential facilities, as provided in the Guideline, are presented in Table 5.

Table 5 Target maximum external traffic noise level

Land Use	Time	Target Noise Level[1], dB(A)
Residential	Day	$L_{Aeq\ (15\ hour)}$ 60
	Night	$L_{Aeq\ (9\ hour)}$ 55

Notes:

1. The target noise level incorporates an allowance for reflection from the façade of the building under investigation.

Where the external traffic noise levels presented in Table 5 are not met at the proposed development the following techniques should be considered to either meet the target noise level at the proposed building façade OR meet the internal noise levels as set out in AS/NZS 2107:2016 and AS/NZS 3671:1989:

- Set-back of the building from the road; and/or
- Acoustic barrier between the building and the road; or
- Building design measures to provide acoustic insulation

Internal noise levels applicable to the development are presented in Table 6.

Table 6 AS/NZS 2107:2016 recommended internal noise levels

Type of Occupancy / Activity	Design Sound Level Range (L_{Aeq}), dB(A)
Houses and apartments near major roads	
Apartment common areas	45 – 50
Living areas	35 – 45
Sleeping areas (night-time)	35 – 40
Work areas	35 – 45s

2.3 Building Code of Australia criteria

The Australian Building Codes Board (ABCB) National Construction Code (NCC) incorporates the Building Code of Australia (BCA). Part F of the BCA provides requirements for acoustic isolation of single sole occupancy units. The proposed buildings will be classified as Class 3 building in accordance with the BCA. Relevant clauses of the BCA are reproduced below in Table 7.

Table 7 BCA acoustic performance criteria summary

	To	Acoustic Performance Requirement
Sound Insulation Rating of Walls		
Sole-occupancy unit - Habitable room	Sole-occupancy unit – Habitable room	$R_w + C_{tr} \geq 50$
	Sole-occupancy unit – Bathroom, sanitary compartment, laundry or kitchen	$R_w + C_{tr} \geq 50$ Discontinuous construction[1]
Sole-occupancy unit – Bathroom, sanitary compartment, laundry or kitchen	Sole-occupancy unit – Bathroom, sanitary compartment, laundry or kitchen	$R_w + C_{tr} \geq 50$
Sole-occupancy unit	Stairway, public corridor, public lobby or the like or parts of a different classification	$R_w \geq 50$
	Plant room or lift shaft	$R_w \geq 50$

	To	Acoustic Performance Requirement
		Discontinuous construction[1]
Sound Insulation Rating of Doors		
Sole-occupancy unit	Stairway, public corridor, public lobby or the like	$R_w \geq 30$
Sound Insulation Rating of Floors		
Sole-occupancy unit	Sole-occupancy unit	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 62$
	Plant room, lift shaft, stairway, public corridor, public lobby or the like	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 62$
Sound Insulation of Services		
Duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity passing through more than one sole occupancy unit	Sole-occupancy unit – Habitable room	$R_w + C_{tr}$ 40
	Sole occupancy unit – Non-habitable room	$R_w + C_{tr}$ 25
Storm water pipe	Sole-occupancy unit – Habitable room	$R_w + C_{tr}$ 40
	Sole occupancy unit – Non-habitable room	$R_w + C_{tr}$ 25

Notes:

1. *Discontinuous construction means a wall having a minimum 20 mm cavity between separate leaves. For masonry, where wall ties are required to connect the leaves, the ties are of the resilient type. For other than masonry, there is no mechanical linkage between the leaves except at the periphery.*

In addition to the performance requirements presented in Table 7 the BCA also includes the following requirements:

- Where a wall required to have sound insulation has a floor above, the wall must continue to –
  - The underside of the floor above; or
  - A ceiling that provides the sound insulation required for the wall.
- Where a wall required to have sound insulation has a roof above, the wall must continue to –
  - The underside of the roof above; or
  - A ceiling that provides the sound insulation required for the wall.
- A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

3.0 Acoustic Assessment

3.1 Environmental noise emission

Noise emission from the proposed development is expected to be produced by building services external plant serving the development.

Rudds Consulting Engineers (Rudds), the mechanical engineer for the project, has advised that the apartments will be served by split system air conditioning. External plant will comprise condenser units located on the rooftop of the corresponding building as presented in Table 8.

Table 8 Summary of external mechanical plant

Location	Serving	Number of Condenser Units	Indicative Plant Selection
West building	1 bedroom unit	17	Daikin RXYMQ3AV4A 9 kW
	2 bedroom unit	39	Daikin RXYMQ4AV4A 11.2 kW
	3 bedroom unit	6	Daikin RXYMQ6AV4A 16 kW
	Communal areas	2	Daikin RXYMQ6AV4A 16 kW
East Building	1 bedroom unit	12	Daikin RXYMQ3AV4A 9 kW
	2 bedroom unit	36	Daikin RXYMQ4AV4A 11.2 kW
	3 bedroom unit	7	Daikin RXYMQ6AV4A 16 kW
	Communal areas	2	Daikin RXYMQ6AV4A 16 kW

Equipment noise levels for the indicative plant selections are provided in Table 9.

Table 9 Plant sound power levels

Unit		Sound Power Level, dB								Overall Sound Power Level, dB(A)
		Octave Band Centre Frequency, Hz								
		63	125	250	500	1k	2k	4k	8k	
Daikin RXYMQ3AV4A	Heating	67	64	64	63	59	54	49	46	64
	Cooling	67	64	64	59	58	54	51	44	62
Daikin RXYMQ4AV4A	Heating	70	67	67	64	61	57	57	44	66
	Cooling	68	65	65	59	60	55	52	45	64
Daikin RXYMQ6AV4A	Heating	71	68	67	62	61	58	53	46	66
	Cooling	69	71	69	62	55	54	47	39	64

Noise emission from the rooftop condenser units is predicted to comply with the criteria presented in Section 2.1 at the adjacent noise sensitive receivers.

In addition to the rooftop condenser units, it is proposed to ventilate the basement carparking with jet fans. These fans are to be located wholly within the basement levels and noise from these fans can be sufficiently attenuated with standard acoustic treatments such as internally lined duct and attenuators and by the building structure.

3.2 Traffic noise intrusion

There is potential for traffic noise intrusion to the development from vehicle movements on Limestone Avenue. AECOM Australia Pty Ltd (AECOM), the traffic consultant) has advised that the traffic movements on Limestone Avenue comprise the following:

- 7am to 10pm: 23,938 vehicle movements
- 10pm to 7am: 1,576 vehicle movements
- 3% heavy vehicles

In addition to the above, the speed limit on Limestone Avenue, adjacent to the proposed development, is 60 km/h.

The following traffic noise levels have been calculated in accordance with Calculation of Road Traffic Noise (CoRTN) at 1 metres from the façade of the proposed development are as follows:

- $L_{Aeq\ (15hour)}$: 64 dB(A)
- $L_{Aeq\ (9hr)}$: 55 dB(A)

These noise levels exceed the target maximum external traffic noise levels presented in Table 5 during the daytime. It is therefore recommended that the façade of the proposed development be designed to adequately attenuate road traffic noise to meet the internal design noise levels presented in Table 6.

The following façade constructions are acceptable to provide sufficient acoustic attenuation for habitable rooms facing Limestone Avenue:

- Single glazing comprising 12.38 mm laminated glass; or
- Double glazing comprising 6 mm glass, 12 mm air gap and 10 mm glass.

Glazing with a lower acoustic performance, eg 6 mm glass, is acceptable for bedrooms and for facades with no line of site to Limestone Avenue.

The required acoustic glazing performances and construction should be reviewed during the detailed design stage to allow for any changes in floor plans and glazing ratios.

3.3 BCA requirements

Inter-tenancy partitions to meet BCA requirements will be determined during the detailed design stage of the project. Indicative constructions are provided in Table 10.

Table 10 Indicative partition constructions

	Acoustic Performance
Wall Constructions	
• 150 mm concrete	$R_w + C_{tr} \geq 50$ BCA deemed to satisfy
• Two layers of 13 mm Gyprock Fyrchek plasterboard • 64 mm staggered steel studs in a 92 mm track. 600 mm centres each side • 60 Soundscreen™ 1.6 batts • Two layers of 13 mm Gyprock Fyrchek plasterboard	$R_w + C_{tr}$ 50 CSR Test TL461
• Two layers of 13 mm Boral Firestop plasterboard • 64 mm staggered steel studs in a 92 mm track. 600 centres each side • 100 mm thick polyester insulation (min 14 kg/m^3) • Two layers of 13 mm Boral Firestop plasterboard	R_w + Ctr 51 Boral tested system by GHA

	Acoustic Performance
• Two layers of 13 mm Gyprock Fyrchek plasterboard • 64 mm steel studs. 600 mm centres • 20 mm gap • 60 Soundscreen™ 1.6 batts • 64 mm steel studs. 600 mm centres • Two layers of 13 mm Gyprock Fyrchek plasterboard	$R_w + C_{tr}$ 50 Discontinuous Construction
• Two layers of 13 mm Boral Firestop plasterboard • 64 mm steel studs. 600 centres • 20 mm gap • 100 mm thick polyester insulation (min 14 kg/m^3) • 64 mm steel studs. 600 centres • Two layers of 13 mm Boral Firestop plasterboard	R_w + Ctr 51 Discontinuous Construction
Floor Constructions	
• Carpet on underlay • 200 mm thick concrete slab • 13 mm suspended set standard plasterboard ceiling • 50 mm glasswool insulation in ceiling cavity	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 62$
• Linoleum/Vinyl floor covering • 200 mm thick concrete slab • 13 mm suspended set standard plasterboard ceiling • 50 mm glasswool insulation in ceiling cavity	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 62$
Separation of Services - Ceilings	
• CAC 35 (eg set plasterboard), and • Acoustically lag pipe OR lay 75 mm thick glass wool insulation with minimum 14 kg/m^3 over ceiling for a minimum of 1200 mm each side of the pipe	$R_w + C_{tr} \geq 25$
• CAC 35 (eg set plasterboard), and • acoustically lag pipe, and • lay 75 mm thick glass wool insulation with minimum 14 kg/m^3 over ceiling for a minimum of 1200 mm each side of the pipe	$R_w + C_{tr} \geq 40$
Separation of Services - Risers	
• 1 x 13 mm plasterboard on metal studs with 75 mm thick glass wool insulation with a minimum density of 14 kg/m^3	$R_w + C_{tr} \geq 25$
• 1 x 13 mm plasterboard on metal studs with 75 mm thick glass wool insulation with a minimum density of 14 kg/m^3 and acoustically lag pipe.	$R_w + C_{tr} \geq 40$

Notes:

1) Suitable acoustic lagging products include Pyrotek SoundLag 4525C, Bradford Acoustilag 45 or Pink 4.5 kg QuietPipe. All acoustic lagging should be installed in strict accordance with the manufacturer's recommendations.

2) A suitable insulation is 75 mm thick Pink Batts Silencer.

4.0 Conclusion

This report presents environmental noise emission criteria for the proposed Foothills Mount Ainslie development at Blocks 4 and 5, Section 38 Campbell, ACT.

Environmental noise emissions from the proposed mechanical plant selections have been assessed and found to meet the established environmental noise emission criteria developed in this report.

Traffic noise intrusion to the proposed development has been assessed and acoustic treatments to meet the recommended internal design noise levels has been determined.

Based upon this assessment, as documented above, all environmental noise impacts can be appropriately managed in accordance with the relevant guidelines and standards.

Appendix A

Glossary of Acoustic Terminology

Appendix A Glossary of Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:

0dB(A)	Threshold of human hearing
30dB(A)	A quiet country park
40dB(A)	Whisper in a library
50dB(A)	Open office space
70dB(A)	Inside a car on a freeway
80dB(A)	Outboard motor
90dB(A)	Heavy truck pass-by
100dB(A)	Jackhammer/Subway train
110 dB(A)	Rock Concert
115dB(A)	Limit of sound permitted in industry
120dB(A)	747 take off at 250 metres

Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period
L_{min}	The minimum sound pressure level measured over the measurement period
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.

L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*.